**MOLES, AND QUANTITIES IN**

**CHEMICAL COMPOUNDS AND REACTIONS**

Multiple Choice Section (Circle Answer on this Page): [1 mark each]

1. How many moles are in 414.5 grams of strontium oxide?

A) 2.41 x 1024 B) 4.0 C) 103.6 D) 3.0 E) 6.02 x 1023

2. For the reaction: 4 NH3(g) + 5 02(g) → 4 NO(g) + 6 H2O(l), the number of moles of water produced per 1 mole of NH3 used up is

A) 6 B) 4 C) 5 D) 2.25 E) 1.5

3. Which of the following is not true?

A) 2.5 moles of SiO2 contain 5 moles of oxygen atoms

B) 1.0 mole of H3PO4 contains 1.807 x 1024 atoms of hydrogen

C) 1.0 mole of NaCl contains 6.022 x 1023 formula units

D) 12.0 grams of CO2 contain 1.0 mole of carbon atoms

E) 32.0 grams of gaseous O2 contain 2.0 moles of oxygen atoms

4. A chemist synthesizes a compound using the isotopes Carbon-13 (13.00335 g/mol) and Oxygen-18 (17.99916 g/mol). He finds the empirical formula is CH2O. What is the approximate (rounded to 1 g/mol) molar mass of the empirical formula that he will eventually need to help calculate the molecular formula?

A) 29 g/mol B) 30 g/mol C) 33 g/mol D) 35 g/mol E) 40 g/mol

5. A compound has the empirical formula CH2FCl, and is found to have a molecular mass of 205.5 grams/mole. What is its molecular formula?

A) CH2FCl B) C3H6F3Cl3 C) C6H12F6Cl6 D) C3H5F3Cl4 E) C2H6F2Cl2

6. For the reaction: Fe2(SO4)3(aq) + 6 NaOH(aq) → 3 Na2SO4(aq) + 2 Fe(OH)3(aq), how many moles of Fe(OH)3 are produced from 3.9 moles of NaOH?

A) 1.3 B) 3.9 C) 2.0 D) 7.87 x 1023 E) 1.81 x 1024

7. What mass of sodium is present in 5.00 grams of sodium thiosulphate Na2S2O3?

A) 2.90 g B) 1.45 g C) 4.05 g D) 2.45 g E) 1.70 g

8. What is the mass of 5.2 moles of magnesium cyanide (Mg(CN)2)?

A) 482 grams B) 126 grams C) 592 grams D) 39 grams E) 397 grams

9. What is the percent by mass of nitrogen in C2H5NO?

A) 11.1% B) 24.1% C) 23.7% D) 55.5% E) 0.24%

10. Which of the following is true?

A) A hydrated compound contains a specific number of water molecules ionically bonded to each formula unit.

B) If you are going to dissolve a hydrate in water, the amount of water in the hydrated compound will not affect mass and mole calculations.

C) If an experimental procedure requires anhydrous copper (II) sulphate, and you only have CuSO4 . 5 H2O, you have no choice but to order a new batch of the anhydrate.

D) Many hydrates can be converted to anhydrous form by gentle heating.

E) The physical properties of an anhydrous compound are always identical to those of its hydrate.

11. Which sample has the greatest mass?

A) 2.0 moles As B) 7.0 moles Ne C) 6.5 moles Cl2 D) 3.0 moles Na E) 1.0 moles I2

12. What mass of Chromium metal contains the same number of atoms as 92.9 grams of Phosphorus?

A) 3.3 moles B) 54.0 grams C) 64.0 grams D) 156 grams E) 1.20 x 1024 formula units

13. The substance that is used up first during a reaction, and determines the amount of possible product, is called

A) stoichiometric quantity B) excess reactant C) equation coefficient D) limiting reactant

E) actual yield

14. If you know the theoretical yield of a reaction, and you are familiar with the percent efficiency of the reaction using your own equipment, then you can calculate the:

A) percent composition B) actual yield C) empirical formula D) molecular formula

E) mole ratio

15. Which of these circumstances can be explained using the law of definite proportions?

i) The percent, by mass, of cobalt in cobalt (II) chloride is always 45.4%

ii) Ammonia, NH3, is represented as consisting of 75% hydrogen by number.

iii) A fixed quantity of carbon can combine with one or two moles of oxygen to form two different carbon oxides

iv) hydrated ionic compounds with the same formula contain the same percent by mass of water

A) all of these B) ii, iii C) i, iii, iv D) i, ii, iv E) none of these

Short Answer Section (Please answer in the spaces below. Show all of your steps, as much as possible, and express your answers using the appropriate number of significant digits.):

1. An unknown compound is found to consist of 24.9 % Iron, 42.9 % Sulphur, and 32.1 % Oxygen, by mass. Determine its empirical formula. [ 7 marks ]

2. An unknown organic compound is found to be composed, by mass, of 3.6 % Hydrogen,

51.4 % Carbon, 22.1 % Phosphorus, and the rest Oxygen. A sample was run through a mass spectrometer and found to have a molar mass of about 420.0 grams/mole.

a) Determine the empirical formula of the compound. [ 6 marks ]

b) Determine the molecular formula of the compound. [ 2 marks ]

3. 6.50 grams of aqueous calcium chloride reacts with 4.32 grams of aqueous lithium phosphate, to produce solid calcium phosphate and aqueous lithium chloride.

a) Write a balanced chemical equation for the reaction [ 1 mark ]

b) Determine the limiting reactant [ 5 marks ]

c) Calculate the mass of calcium phosphate produced in this reaction. [ 3 marks ]

4. Equal masses of calcium sulphide and hydrogen bromide react according to:

CaS(aq) + 2 HBr(aq) → CaBr2 + H2S(g)

Which reagent is in excess, and what percentage of it will remain at the end of the reaction? [9 marks]

5. Explain how an understanding of both mass and moles helps us obtain the percentage composition, and the empirical formula, of a compound. (Hint: Think about the process of going from percentage composition to empirical formula, and the information that the empirical formula gives us). [3 marks]